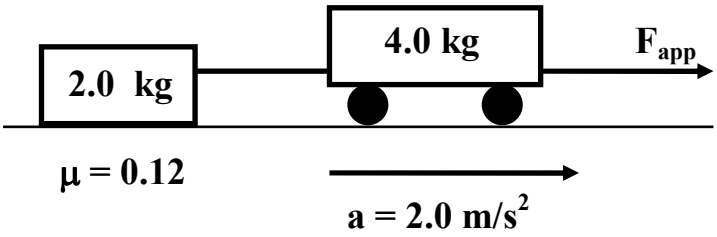
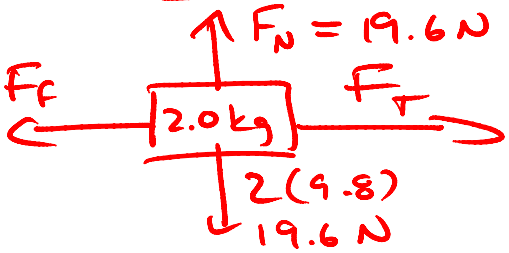
Example #12. Two masses shown below are connected together and pulled by an applied force to the right, causing an acceleration of 2.0 m/s^2. There is a coefficient of friction between the 2.0 kg mass and the floor, while the friction between the cart and the floor is negligible. Find:



a) the tension in the string attaching the two masses.
b) the applied force used to pull the system.

a) We can draw a f.b.d. of either the cart or the mass in order to find F_T. The mass is the only f.b.d. with one unknown value, so analyze it:



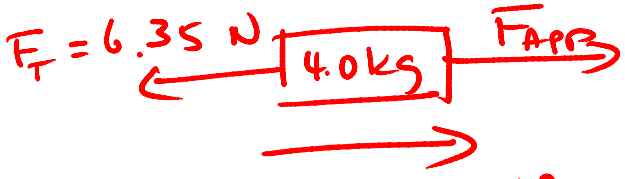
$\Rightarrow F_f = \mu F_N$
$= .12(19.6)$
$= 2.35$ N

$a = 2.0$ m/s^2 $\Rightarrow F_{Net} = 2(2)$
$= 4.0$ N

$\rightarrow F_{Net} = F_T - F_f$ $\quad 4.0 = F_T - 2.35$

$\boxed{F_T = 6.4 \text{ N}}$ (6.35)

b) f.b.d. of the cart:



$\Rightarrow$ no friction, so F_g, F_N not needed.

$a = 2.0$ m/s^2

$F_{Net} = 4(2) = 8.0$ N

$\Rightarrow F_{Net} = F_{App} - F_T \qquad 8.0 = F_{App} - 6.35$

$$\boxed{F_{App} = 14\ N}$$

The value of F_{App} could also be found by analyzing a f. b. d. of the whole system.